Los Angeles Trade Tech. Jr. College
Instructor: R. H. Oeffinger

TR-
Technician: Agustin Lucas

Date: May 30 1957

ELECTRONICS TECHNICIAN

TECHNICAL REPORT

Title: Limiting Circuits

A limiter circuit is a circuit that limits or clips the positive or negative peaks of a wave to some predetermined level.

Limiters are used to change the shape of a wave. A sine wave may be changed to a sqare wave and so on.

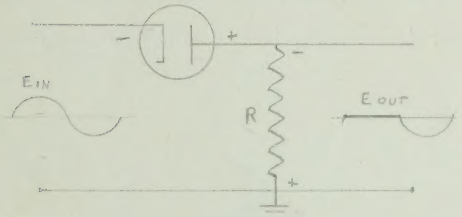
In FM reception limiters are used to clip amplitud modulation of the carrier caused by distortion.

Types of limiters: Series Diode Limiters, Parallel Diode Limiters, Double Diode Limiters, Grid Limiters, Saturation Limiters, Cut-Off Limiters and the Overdriven Amplifier.

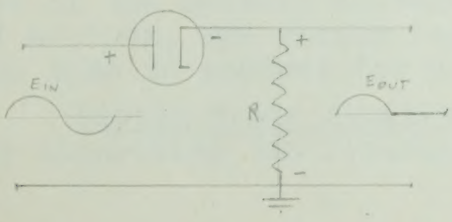
Series Diode Limiting:

Some review points about a diode. The tube will conduct only when the plate is positive with respect to the cathode, or the cathode is negative with respect to the plate. A posite potential may be placed on the cathode, in which case the tube will not conduct until the voltage on the plate rises above an equal positive value. As the plate becomes more positive, the current increases and the plate to cathode resistance decreases to about 500 ohms.

The sries diode limiter may be used to limit the positive or negative peaks of a wave.



Series diode to limit positive peaks. The tube operates like a rectifier, if the resistor is very large compared to the resistance of the tube when is conducting. With the diode connected as shown, the output will be zero during the positive peak, since the cathode will be positive with respect to the plate. The tube will not conduct and the voltage across the resistor will be zero. During the negative peak, the cathode will be negative with respect to the plate, the tube will conduct and the voltage across the resistor will follow the input wave.

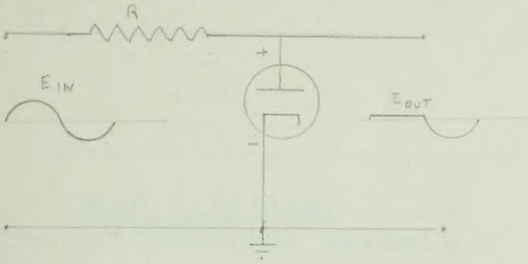


Series diode to limit the negative peaks. Reversing the diode will limit the negative since during the negative peaks the plate will negative with respect to the cathode and no voltage will appear across the resistor.

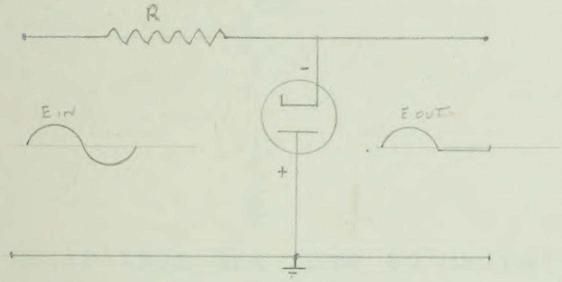
✓

Parallel diode limiting:

The diode may be connected in parallel to limit either the positive or negative peaks at ground potential.

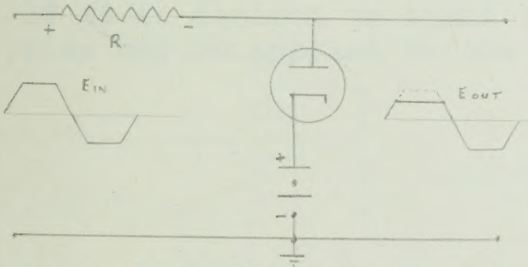


Positive limiting. Since the cathode is held at ground potential, the diode conducts through the entired positive peak, acting like a short circuit with all the signal voltage dropped across the resistor, having practically no output at the output terminals. During the negative peaks the plate is negative, therefore the does not conduct. Since there is no current flowing, no voltage is dropped across the resistor and the output is equal to the negative peak of the input.

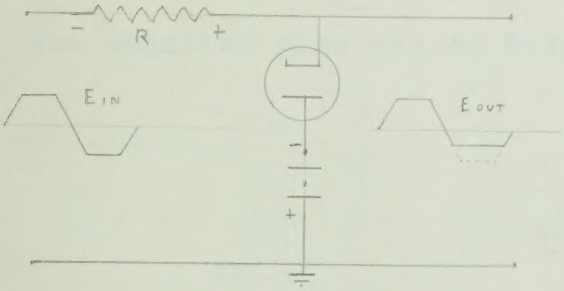


Negative limiting: With the diode reversed in this case, the plate is held at ground potential and the tube will conduct only during the negative peaks, when the cathode is more negative then the plate. And like in the case above, the peak that makes the tube conduct will be lost to the output, in this case the negative peak.

The peaks need not be limited to ground potential. They may be limited at any positive or negative value by holding the proper diode element at that value.



Positive limiting above groung potential: To be able to do any limiting the bias voltage must be less than the value of the peak voltage of the input signal. When no signal is applied, the cathode is more positive than the plate. The tube will not conduct until such a time when the input signal voltage is greater than the bias voltage. At this point the tube will conduct, and that section of the positive peak will be clipped.

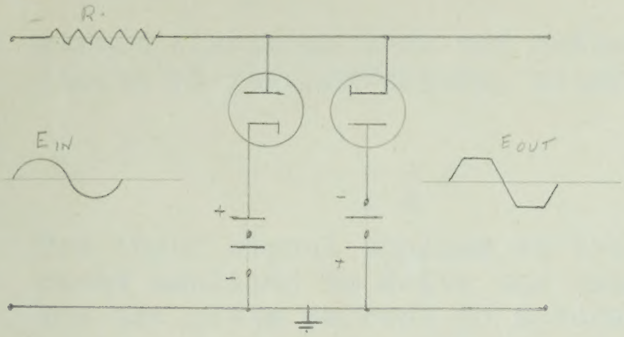


Negative limiting below ground potential: In this case with the diode reversed, the plate is at the negative potential of the battery. Thus as long as the input voltage is positive or less negative than the plate, the tube will not conduct and the output will follow the input. When the cathode becames more negative, the diode will conduct, clipping that section of the negative peak.

In both of these cases the amount of peak limiting will depend on the value of the battery voltage. If is necessary to clip one whole peak plus part of another, one simply decreases the value of the battery voltage to allow the tube to conduct for a longer period of time and vice-versa.

Double Diode Limiting:

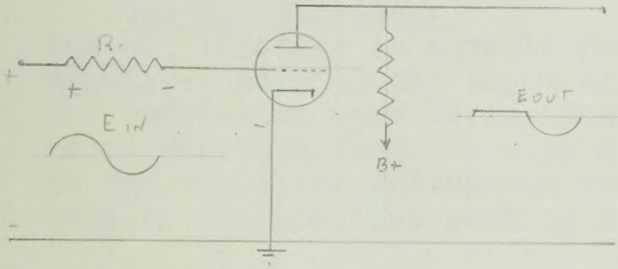
By connecting two reversed diodes in parallel both amplitudes may be clipped.



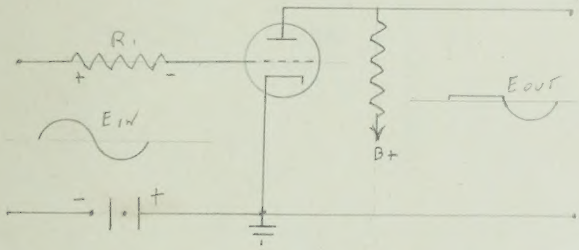
In this case the first diode conducts when it's plate is more positive than the bias voltage, clipping a section of the positive peak. The second diode will conduct when it's cathode becomes more negative than the battery voltage on the plate, clipping a section of the negative peak. Here again the amount of limiting may be controled by the value of the battery voltage.

Grid Limiting:

The grid-cathode circuit of any triode, tetrode or pentode may be used to limit the positive peaks of an input signal.

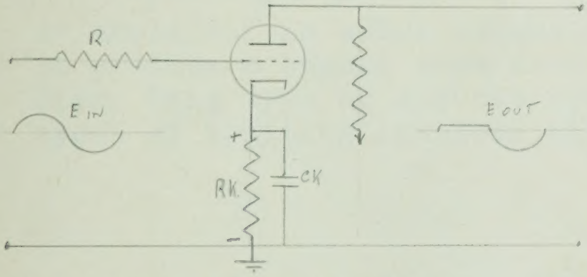


The grid resistor is of very large value compared to the grid to cathode resistance when the grid draws current.
In this type of circuit the grid is held at zero bias. As the signal drives the grid into the positive region, grid current flows and produces a negative voltage across the resistor which acts as bias for the tube. Since the value of the resistor is much greater than the grid to cathode resistance when the grid is drawing current, most of the input voltage of the positive peak is dropped across the resistor and only a very small portion is actually applied between grid and ground. Effectively then, the positive peaks are flattened due to the flow of grid current.
If it is desired to limit the positive peak at a higher value a negative bias may be applied to the grid



In this circuit no current will flow until the positive input signal overrides the bias voltage. Then the grid will draw current and the signal will be limited by the drop across the grid resistor.

The negative bias may be developed by the cathode resistor method.



The grid is held normally at at ground potential, which is negative with respect to cathode. Any positive peak must drive the grid positive by an equal amount to the cathode bias, before this effect is removed. As the signal increases in the positive direction, grid current flows, which results in the limiting of the voltage at the grid.

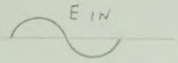
Saturation Limiting:

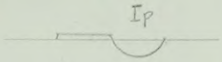
If a seriee grid resistor is used the grid can not be driven to an appreciable positive value and therefore, the maximum plate current is determined by the plate supply voltage.
The grid limiting resistor may be omitted if the signal comes from a low impedance source an limiting in the plate circuit may stillbe realized, due to the plate current saturation.
By using a large value of plate load resistor and low plate supply voltage, saturation limiting may be produced by a low amplitud of the positive input signal. The negative peaks of the output will be clipped, but not at zero value, since a small positive voltage must remain on the plate, to

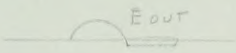
Digitized by the Internet Archive
in 2023 with funding from
Amateur Radio Digital Communications, Grant 151

https://archive.org/details/limitingcircuits00unse

atract electrons from the cathode. Therefore. where the grid limiting limits at zero reference, saturation limiting does it at a higher value.



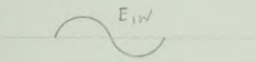


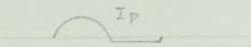


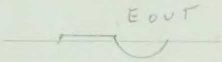
The input signal applied to the grid, which is at zero bias, is not of sufficient amplitud to drive the tube to cut-off on the negative swing, but causes the plate current to saturate on the positive swing. The maximum plate current defines the lowest value to which the plate voltage can fall. During the remaining portion of the input cycle, the grid controls the flow of plate current which determines the shape of the output voltage.

Cut-Off Limiting:

Cut-off limiting is acomplished, by driving the grid to cut-off during the negative peaks of the input signal. At this time the plate current is zero and remains at zero during the time the grid is below cut-off. Since no current flows through the load resistor there is no voltage developed across it and the plate voltage is maintained at full value. Thus limiting is achieved on the positive peak of the output voltage.

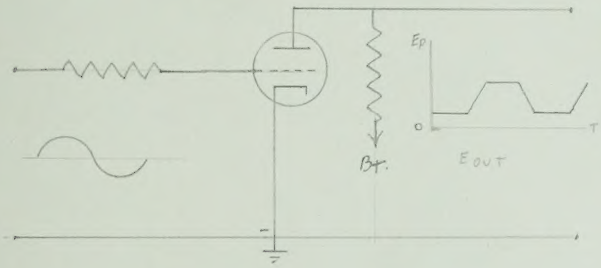






The grid is normally held at a negative potential by some kind of bias, normally cathode bias. This value of bias is selected so cut-off is acomplished at the desired point.

A combination of grid limiting and cut-off limiting may be employed to produce a square wave from a sine wave. The amplitud of the input voltage must be sufficiently high to hold the grid beyond cut-off for a greater part of the negative swing. The grid resistor limits the grid voltage to zero during the positive swing.



Overdriven Amplifier:

An amplifier in which saturation limiting is used with cut-off limiting to produce a square wave from a sine wave is known as an overdriven amplifier. This type of circuit operates under the conditions explained for both types of limiting involved with the exception that a large signal is needed.